Write your name here

Surname	Other names

Centre Number | Candidate Number

Edexcel GCE

Biology

Advanced Subsidiary

Unit 3B: Practical Biology and Research Skills

Wednesday 12 January 2011 – Afternoon
Time: 1 hour 30 minutes

Paper Reference
6BI07/01

You must have:
Ruler, Calculator, HB pencil

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

Information

- The total mark for this paper is 40.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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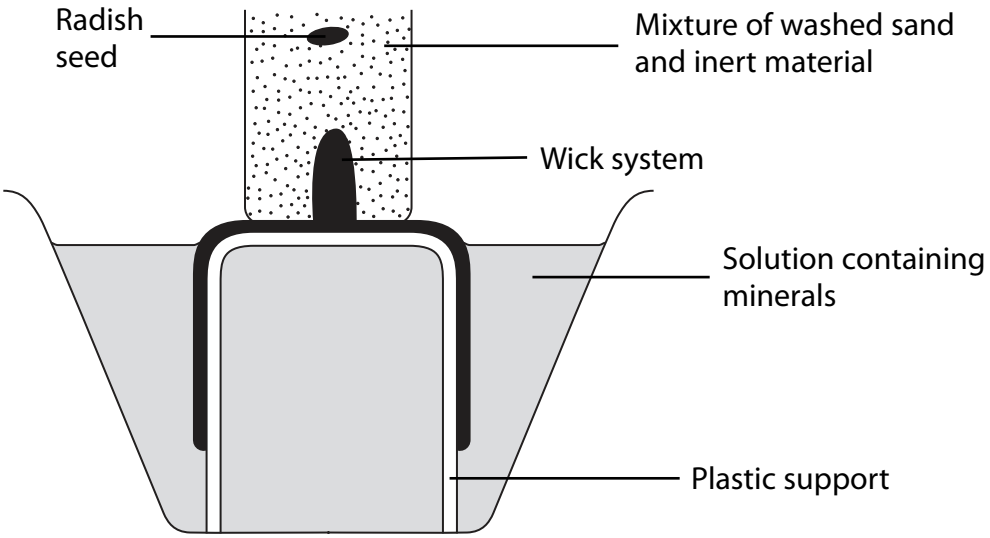
Answer ALL questions

1 Farmers spend a lot of money every year adding fertiliser to their crops.

A student wondered whether this is money well spent and which are the most important minerals to add.

These questions led him to do a simple 'mineral deficiency' investigation. He grew radish plants (*Raphanus sativus*) in pots containing a mixture of washed sand and an inert material. The pots absorbed water and minerals, via a wick system, from a solution containing all the minerals required.

This is shown in the diagram below.



The student took radish seeds of about the same mass and put one seed into each of ten pots. The pots were left for three weeks for the seeds to germinate and the radish seedlings to grow. The student then counted the number of seedlings and recorded the mean dry mass of the shoots (stems and leaves) and roots.

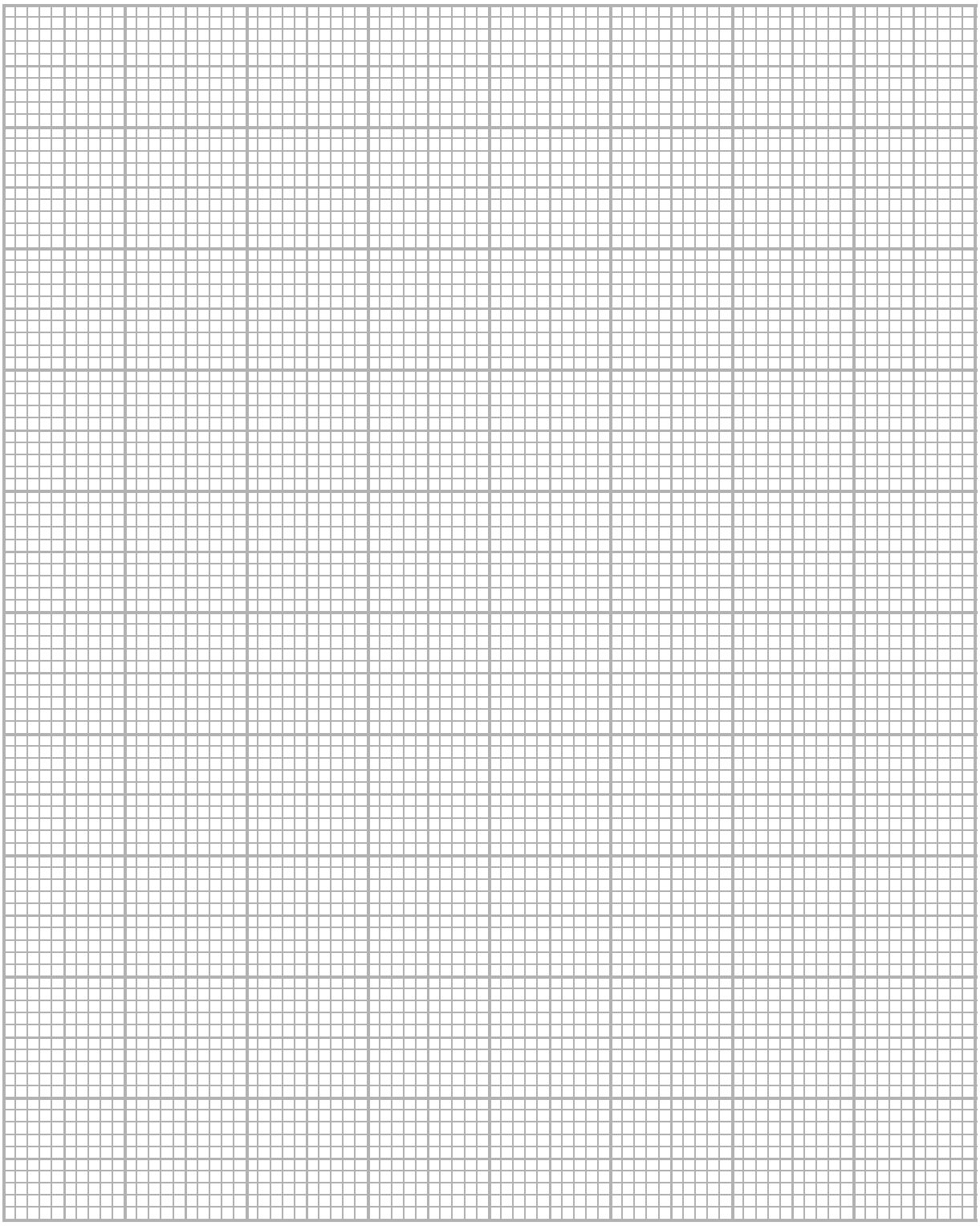
The experiment was repeated six times using different solutions, each of which had one mineral missing.

The results of this investigation are shown in the table below.

Solution	Number of plants in final sample	Mean dry mass / mg		
		Shoots	Roots	Total
With all minerals present	8	235	139	374
Without potassium	10	188	139	327
Without iron	8	231	96	327
Without nitrate	10	141	75	216
Without calcium	9	167	40	207
Without magnesium	9	178	29	207
Without phosphate	9	186	16	202

(a) (i) Plot the data from the table, in a suitable graphical form, to compare the mean dry masses of shoots and roots in each of the solutions.

(4)



(ii) Calculate the dry mass of all plant material from the seedlings grown in the solution without magnesium.
Show your working.

(2)

Answer ..... mg

(iii) Describe and suggest an explanation for the effects of a deficiency of magnesium and nitrate on the growth of radish seedlings in this investigation.

(6)

(b) (i) Suggest why it was important to make sure all the seeds were about the same mass at the start of this investigation.

(1)

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(ii) State the **independent** variable in this investigation.

(1)

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(iii) State **two** variables, other than seed mass, that need to be controlled in this investigation.
For each variable, describe how it could be controlled.

(4)

Variable 1 .....

How it could be controlled .....

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Variable 2 .....

How it could be controlled .....

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(iv) The dry mass of shoots and roots was measured in this investigation.
Describe how to find the dry mass of shoots and roots.

(2)

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(Total for Question 1 = 20 marks)

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2 The following is an extract from a student's report on the topic of the acidification of oceans.

The Acidification of Oceans and how it affects Coral Reefs

The oceans play a vital role in global biogeochemical cycles. At the moment the oceans are absorbing too much carbon dioxide (CO_2) from the atmosphere. As a result the oceans are becoming more acidic (i.e. decreasing the pH). The CO_2 dissolved in the ocean reacts with water to make carbonic acid (H_2CO_3); which disassociates into H^+ and HCO_3^- ions and this increases the water's acidity.

In the past 200 years the oceans have absorbed approximately half of the CO_2 produced by fossil fuel burning and cement production. This intake of CO_2 has led to a reduction of the pH of the oceans surface waters by 0.1 units which is equivalent to a 30% increase in the concentration of hydrogen ions. This means that if global emissions of CO_2 from human activities continue to rise the average pH of the oceans could fall by 0.5 units by the year 2100 which could cause severe damage in all types of areas.

Coral reefs are made up of calcium carbonate (in other words limestone) secreted over thousands of years by billions of tiny soft bodied animals called coral polyps. Coral reefs are the world's most biodiverse marine ecosystems and are home to 25% of all identified marine ecosystems. Coral reefs occupy less than 0.25% of the Earth's marine environment, yet are home to more than 25% of all known fish species. However, the changes caused by an excess of carbon emissions given out from human usage at present and in the future will cause severe damage to these ecosystems specifically those situated in the Southern Ocean like the Great Barrier Reef. Sea creatures such as corals, shell fish, sea urchins and star fish are likely to suffer the most because higher levels of acidity make it difficult for them to form and maintain their hard calcium carbonate skeletons and shells.

The tourist industry associated with corals will also suffer. People travel thousands of miles to see the rare coral reefs of the world for example, the Great Barrier Reef. Sadly this means that the economic status of those places where tourists would normally go will most probably drop a significant amount. Also, in the longer term, changes to the stability of coastal reefs may reduce the protection they offer to coasts, threatening people's homes and livelihoods.

Ocean acidification is essentially irreversible during our lifetimes; it will take tens of thousands of years for the oceans to return to the conditions of pre-industrial times. Methods have been tried to reduce ocean acidification but our ability to do this is presently unproven.

The magnitude of ocean acidification can be predicted with a high level of confidence, but impacts on marine organisms and ecosystems are much less certain. Because of their particular physiological attributes, some organisms will be more affected than others. For example, there is evidence to suggest that acidification will affect the process of calcification, by which animals such as corals and molluscs, like periwinkles, make shells and plates from calcium carbonate. It is predicted that the tropical and subtropical corals such as those in the Pacific Ocean will be among the worst affected, although cold-water reefs are also likely to be adversely affected.

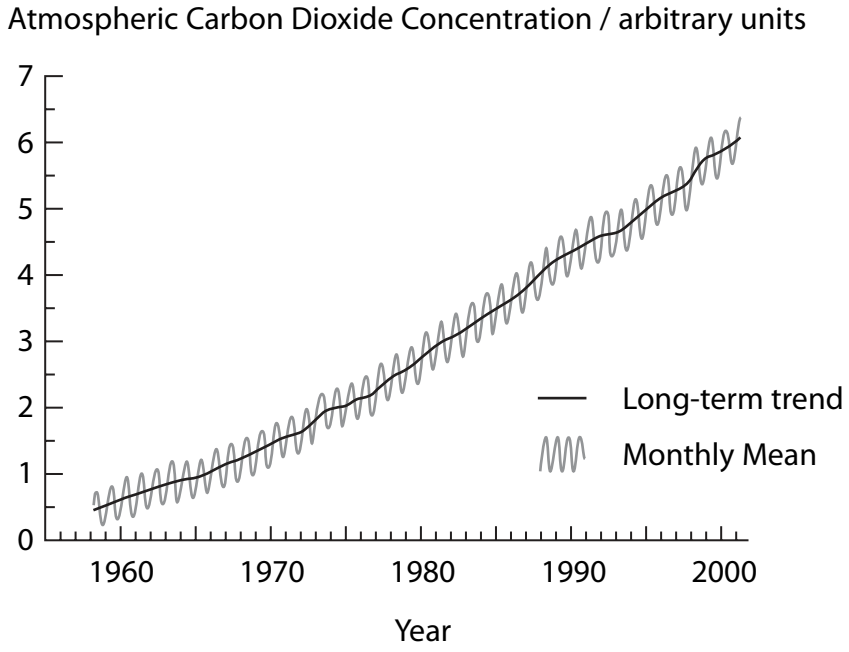
It is also not certain whether marine species, communities and ecosystems will be able to adapt in response to changes in the ocean chemistry. If the pH of the ocean is continually falling then it will take longer for various species to acclimatise to the new conditions. Some may not acclimatise at all meaning that species important to marine ecosystems like zooplankton will die off all together.

What can be done to reduce Ocean Acidification? Along with climate change, the rising acidity of our oceans is yet another reason for us to be concerned about the carbon dioxide we are pumping into the atmosphere. This means that reducing CO_2 emissions to the atmosphere appears to be the only practical way to minimise the risk of large-scale and long-term changes to the oceans. However, at present research into the impacts of high concentrations of CO_2 in the oceans is in its infancy and needs to be developed quickly. Basic chemistry leaves little doubt that burning fossil fuels is changing the acidity of the oceans.

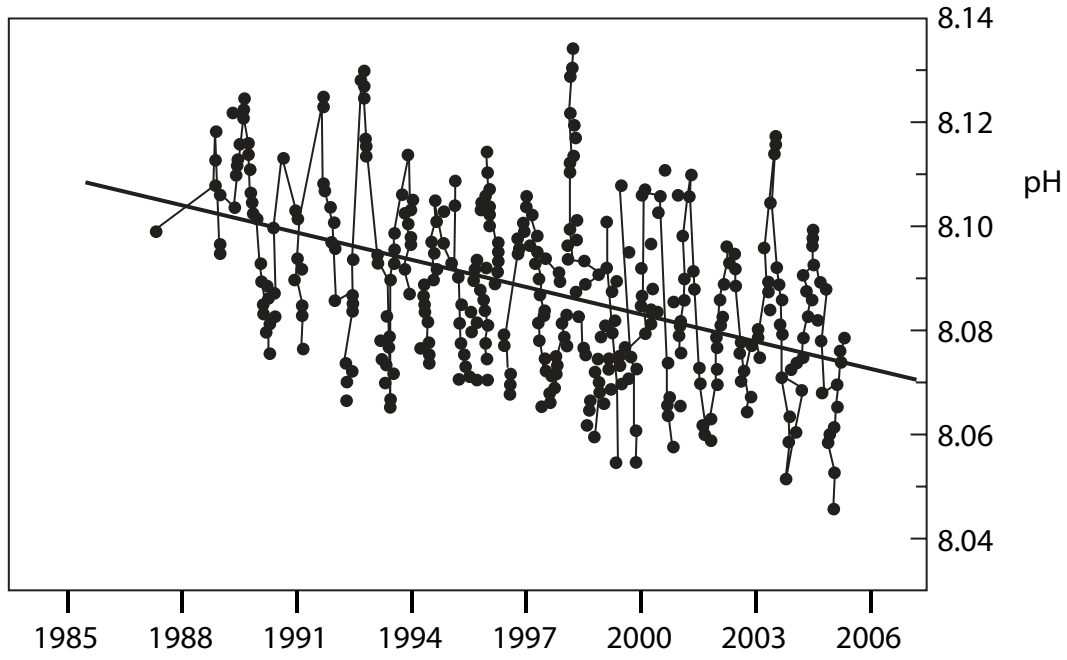
Action needs to be taken now or in the very near future to reduce global CO_2 emissions to the atmosphere in order to avoid the risk of irreversible damage to the oceans. World leaders should be alerted to this issue as a whole so that they can take action. Perhaps by setting targets for the reduction of CO_2 emissions because otherwise something like a marine ecosystem will not exist and will cause the world a lot of damage. We need the oceans to exist even though they are taken for granted.

The report lacks data to support what it is saying.
The student thought that the following two graphs (A and B) would be useful.

Graph A: Graph showing atmospheric carbon dioxide changes over time at Mauna Lau in Hawaii



Graph B: Graph showing pH changes in the long term data set from the ocean around Hawaii



(a) (i) Suggest where in the report you would put graph A and graph B. State the line number and give reasons for your choice for each graph.

(4)

I would insert **Graph A** in the report at line number .....

Reason .....

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I would insert **Graph B** in the report at line number .....

Reason .....

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(ii) The student's report states that "the oceans are absorbing too much carbon dioxide from the atmosphere. As a result the oceans are becoming more acidic".
To what extent do graphs A and B support this statement?
Explain your answer.

(4)

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(b) A visit or issue report is expected to address two of the following implications: ethical, social, economic or environmental. Identify, using line numbers, one social implication and one economic implication in this report.

Explain why you have chosen each implication.

(4)

Social implication

Line number .....

Explanation .....

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Economic implication

Line number .....

Explanation .....

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(c) The report suggests, at lines 29–30, that coral reefs offer significant protection to coasts. This protection might decrease in future years.

The student found some data, shown in the table below, to help support this view.

Year	Percentage offshore wave energy reaching the coast (%)						
	Reef 1	Reef 2	Reef 3	Reef 4	Reef 5	Reef 6	Mean
1994	1	11	8	9	4	14	7.8
2004	2	16	13	19	9	19	
2014	4	23	38	36	18	21	23.3

He calculated the mean percentage offshore wave energy reaching the coast and added this to the table.

(i) Calculate the mean percentage offshore wave energy reaching the coast for 2004.

(1)

Answer ..... %

(ii) The student decided to present the data as a graph. Describe a suitable graphical form for the data.

(2)

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(iii) Describe the trend shown by the data.

(2)

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(iv) Suggest the risks to humans and other organisms, living on the coast, of this change in wave energy.

(2)

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(v) The wave energy data were produced from a mathematical model which estimated past and future wave effects.

Give **one** reason why the conclusions drawn from such a model should be viewed with caution.

(1)

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(Total for Question 2 = 20 marks)

TOTAL FOR PAPER = 40 MARKS

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